Algebraic Reasoning Teacher Wraparound Edition

Algebraic Reasoning TEKS for the lesson are cited in the TWE.

Tips for instruction, such as **Technology Integration** or **ELL Strategies** are provided throughout the lesson.

Mathematical processes are integrated throughout each lesson. The **Mathematical Process Spotlight** features one mathematical process that is showcased in this lesson.

Key **Vocabulary** terms are identified so teachers can use vocabulary support strategies such as Frayer models to preteach the vocabulary for the lesson.

Materials, if necessary, are identified for the Explore activities.

Answers for all student questions are provided, including answers to look for when there are multiple answers possible. When necessary, tables, graphs, and lengthy answers are provided in the margin.

1.3 Modeling with Linear Functions

FOCUSING QUESTION. How can you use finite differences to construct a linear model for a data set?

LEARNING OUTCOMES

- I can use finite differences to write a linear function that describes a data set.
- I can apply mathematics to problems that I see in everyday life, in society, and in the workplace.

ENGAGE

Mariette, a dendrochronologist, observed that some tree stumps have rings that are close together while other tree stumps have rings that are farther apart. Why does a tree stump have rings? What might cause the rings to be closer together or farther apart?

Image credit: Adrian Pingstone, Tree ring, Wikimedia Commons

EXPLORE

Each year during the growing season, trees grow larger by adding another layer of cells just beneath the bark. This layer is called a tree ring. Because a tree ring is added each year, scientists can determine the age of a tree by counting the number of tree rings that are present.

However, not all tree rings have the same width. Trees grow more when there is plenty of rain and the soil is fertile. Scientists can draw conclusions about temperature and rainfall for a particular year based on the width of the tree ring for that year.

Mariette measured the width of tree rings from a core sample she took fro oak tree in the Brazos River valley of central Texas. From the tree ring calculated the radius of the tree. The table below shows her results.

YEAR	2000	2001	2002	2003	2004	20
YEAR NUMBER	0	1	2	3	4	
RADIUS (CM)	2.5	3.1	3.5	3.9		5.5

UNCTIONS 25

TEKS

AR.2D Determine a function that models real-world data and mathematical contexts using finite differences such as the age of a tree and its circumference, figurative numbers, average velocity, and average acceleration.

MATHEMATICAL PROCESS SPOTLIGHT

AR.1A Apply mathematics to problems arising in everyday life, society, and the workplace.

ELPS

Note: ELPS will be placed here once they have been released.

VOCABULARY

linear function, finite differences

MATERIALS FOR THE EXPLORE ACTIVITY

- graphing calculator, spreadsheet, or a graph application

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TECHNOLOGY INTEGRATION

When modeling with real-world data, a scatterplot of the data set and the function model helps students visualize the relationship between the two variables. Scatterplots can be made using graphing calculators, spreadsheets, or graphing apps.

ELL STRATEGY

Writing with newly acquired vocabulary (ELPS: c5B) helps English language learners internalize the vocabulary terms that they have recently learned. Using vocabulary from current and past learning experiences (e.g., linear function, finite differences) to explain their thinking and mathematical reasoning reinforces how these terms are consistent through a variety of settings and contexts.

REFLECT ANSWERS:

Use an average value of the first differences as the slope of a linear function model.

Use your linear function model to write an equation where the linear function is equal to a particular value. Then, solve for x.

1. Calculate the finite differences between the year number and the radius.
   See margin
2. Are the first differences in the radius constant? Explain how you know.
   The first differences in radius are not exactly constant but are very close in value.
3. What is the average finite difference in radius?
   0.5 cm
4. Use the information from the table to write a function rule that models the data.
   f(x) = 2.5 + 0.5x, where x represents the year number, or number of years since 2000.
5. What do the slope and y-intercept from your function rule mean in the context of this situation?
   See margin
6. Use your model to predict the radius of the tree in 2015.
   f(15) = 2.5 + 0.5(15) = 10 centimeters
7. In what year will the radius of the tree be 12.5 centimeters?
   f(x) = 2.5 + 0.5x = 12.5, x = 20, so the year will be 2020
8. What would the circumference of the tree be in 2015?
   C = 2πr = 2π(10) = 20π ≈ 62.8 centimeters
9. Make a scatterplot of your data set and graph the function model over the scatterplot. How well would you say the function model predicts the actual values in the data set? Explain your reasoning.
   See margin

REFLECT

- **How can you determine a linear function model for a data set if the first differences are not exactly the same, but are almost constant?** ***See margin.***
- **Once you have your linear function model, how can you use the model to determine a value of the independent variable that generates a particular value of the dependent variable?** ***See margin.***

26 CHAPTER 1: ALGEBRAIC PATTERNS

1.

+1 +1 +1 +1 +1 +1

YEAR	2000	2001	2002	2003	2004	2005	2006
YEAR NUMBER	0	1	2	3	4	5	6
RADIUS (CM)	2.5	3.1	3.5	3.9	4.4	4.9	5.5

+0.6 +0.4 +0.4 +0.5 +0.5 +0.6

5. *The slope, 0.5 centimeters per year, represents the growth rate of the tree, or the number of centimeters that the radius of the tree grows each year.*

   The y-intercept, 2.5 centimeters, represents the dius of the tree in the ar 2000, when the data ere first collected.

9. *The function model connects several of the data values and is very close to the remaining data values. The function model appears to closely predict the actual data values.*

   See page 27.

26 CHAPTER 1: A

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